

REMARKS/ARGUMENTS

Reconsideration and withdrawal of the Examiner's rejection of the above-identified application is requested in view of the foregoing amendments and following remarks. The claims are 1-3 and 6-11. Claims 1 and 11 have been amended. No new matter has been added.

Claims 1-3 and 7-11 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Hashimoto et al.* U.S. Patent No. 4,350,665 in view of *Dunster et al.* U.S. Patent No. 4,865,820. The remaining claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over *Hashimoto et al.* in view of *Dunster et al.* and further in view of *Zardi* U.S. Patent No. 4,372,920.

This rejection is respectfully traversed and reconsideration is respectfully requested. Claims 1 and 11 have been amended to specify that the oxygen jets do not overlap each other prior to reaching the catalyst bed. This can be seen in the drawings, in particular in FIGS. 2 and 4.

The Examiner states that: "...increasing or decreasing the space above the catalyst bed, is not considered patentably

distinct unless a new or unexpected result is obtained." This sentence is applicable to most previously known nozzle-jetting methods in which the fed-in gas is essentially distributed in the whole space via catalysts, for example:

- according to Hashimoto (US 4,350,665) "gas blowing nozzles counter currently 90-135°"
- or according to Zardi (US 4,372,920), Fig. 1, quench gas QG fed by toroidal distributor 2 without a determined defined arrangement of the nozzles.

The dwell time can then only be reached by decreasing the mixture chamber or by increasing the speed (for example, 9 m/s in Dunster).

In the present invention, the speed of the gas above the catalyst bed is limited due to high pressure loss in the bed (\geq 1 bar). The surface of the catalyst ballast in a big reactor ($D > 3$ m) is not ideally flat, therefore, the distance of the nozzles from the catalyst cannot be arbitrarily reduced. According to experience, the distance should be $> 60 - 100$ mm.

The problem to be solved, therefore, was to feed-in the oxygen in such a way that it is quickly mixed with the

surrounding gas and reaches the catalyzer in a short time without increasing the speed of the surrounding gas, and with a distance nozzle - catalyzer of at least 60 - 100 mm.

According to the invention, this problem was solved by the special arrangement of the nozzles. The method developed by us was first tested in the laboratory, whereby a small cylindrical reactor with a vertical, downwardly arranged nozzle was used. Thereby, upward flow of the mixture in the rim zone of the reactor was observed, similar as in Fig. 3 of the present patent application, whereby the dwell time of the mixture was clearly extended, non-desired non-catalytic reactions were increased, and the yield of the product was decreased.

According to the invention, the nozzles for oxygen-feed are not arranged in a vertical manner, but are slightly inclined, whereby the upward flow can be reduced. Thereby, oxygen is present substantially only in the jets which move fast in the direction of the catalyzer, and in contrast, the predominant part of the space between nozzles and catalyzer is oxygen-free.

Figs. 2-4 show the expansion cones of the jets. These cones do not overlap in the space above the catalyzers, i.e. the jets

do not touch each other in the free space. Only when the jets are impeded and rerouted by the catalyzer surface, is the space between the rays filled with the gas mixture. The half angle of the cones is 7 - 10°.

Furthermore, the specific nozzle arrangement according to claim 1 provides distinct differences from the cited references. The nozzle arrangement according to the invention is simulated with CFD, as shown in the attached Appendix A. The parameters are as follows:

- gas velocity 2 m/s
- oxygen velocity > 100 m/s
- distance nozzles - catalytic head 63 mm.

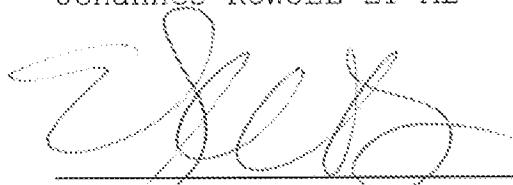
As shown in the first Figure in the attachment, an oxygen content above 3 mole % is only present inside of the jets. The upper part of the space between the distributor and catalyst is oxygen-free and only a thin layer above the catalyst bed contains more than 1 mole % oxygen.

In the second Figure, in a distance of 63 mm from the nozzles, the velocity in side of the jets is reduced from approximately 100 m/s to 10 m/s.

The third Figure is a histogram showing the residence time distribution of oxygen between the nozzles and the catalyst surface. The average residence time is 12 ms. If oxygen is injected as taught by Hashimoto, or as shown in FIG. 3 of the present application, and the whole space between the distributor and catalyst (height of approx. 100mm) contains gas=oxygen mixture, the residence time would be 100mm: 2 m/s = 50 ms. The residence time in the present invention of 12 ms is 4 times lower than 50 ms. Therefore the yield losses caused by non-catalytic oxidation are significantly lower. The reduction or residence time is achieved not by increased gas velocity and not by a reduction of the distance between the distributor and catalyst, but by the special arrangement of the nozzles as claimed in claim 1 - (jetted on the catalyst surface at an inclined angle).

In summary, claims 1 and 11 have been amended. In view of the foregoing, it is respectfully requested that the claims be allowed and that this application be passed to issue.

Respectfully submitted,
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Enclosure: Appendix A

I hereby certify that this correspondence is being filed electronically in the U.S. Patent and Trademark Office on July 11, 2011.

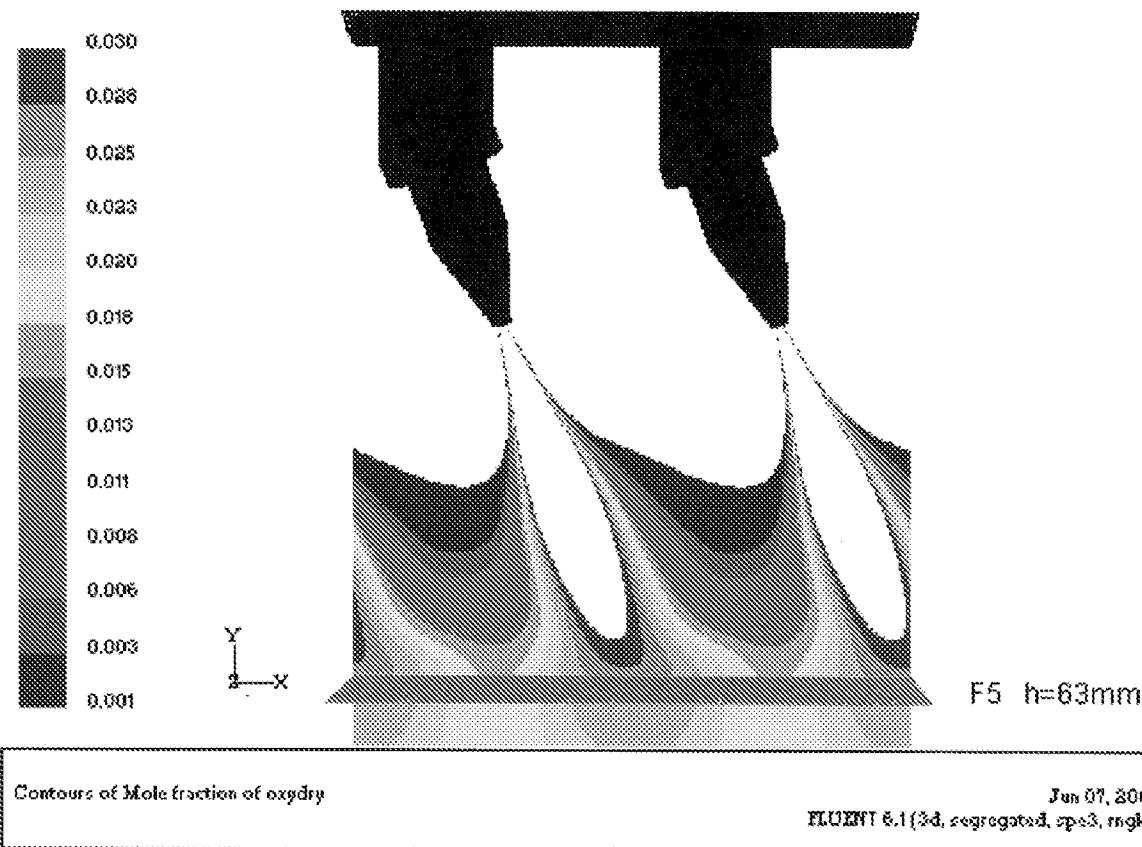


Elizabeth C. Richter

Response to KOWOLL ET AL-2 PCT/US10/04866 in Response to Final OA 6-31 wpd

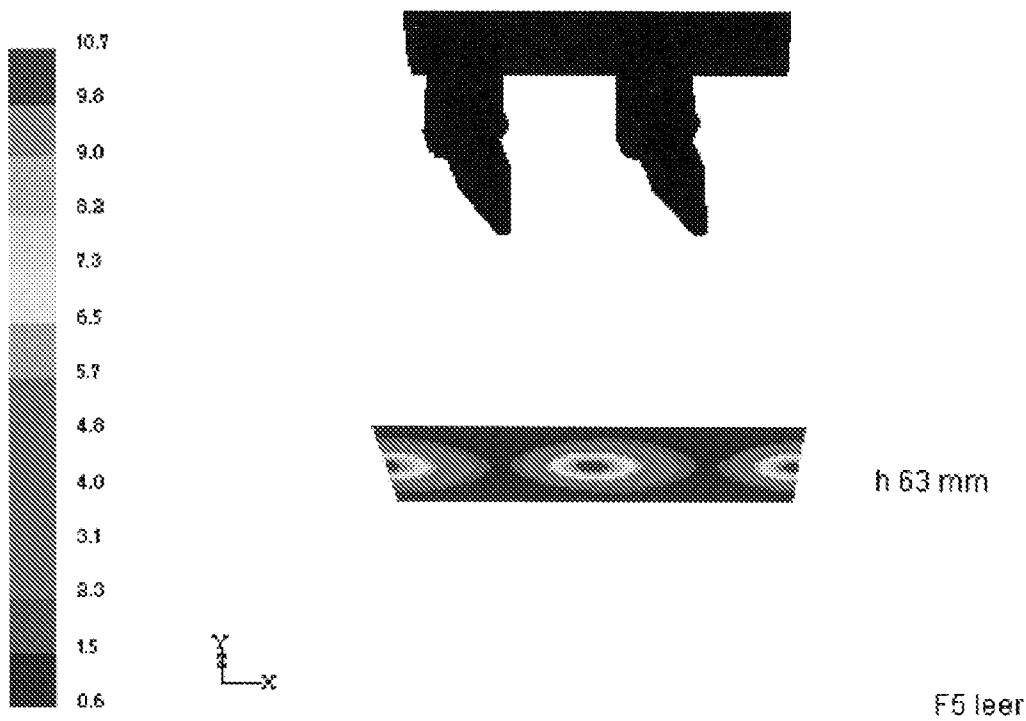
APPENDIX A

Please find attached a revised version of old pages 3-4 reprinted by pages 3-5 with improved quality of figures



The figure "Contours of Mole fraction of oxydry" shows oxygen content above 3 mole% (white color surrounded by red) only inside of jets.

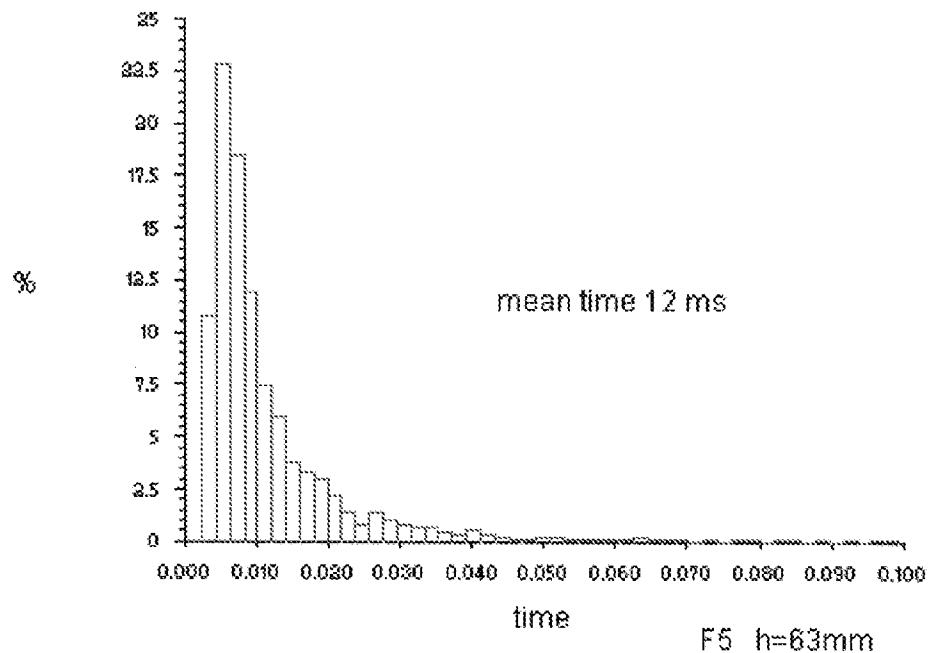
The upper part of the space between distributor and catalyst is oxygen- free and only a thin layer above catalytic bed contains more than 1 mole% oxygen.



Contours of Velocity Magnitude (m/s)

Jun 15, 2004
FLUENT 6.1 (3d, segregated, spe3, rmk6)

In the distance of 63 mm from nozzles the velocity inside of jets is reduced from approx. 100 m/s to 10 m/s.



Histogram of time

Jun 07, 2004
ELUENT 6.1 (3d, segregated, spc3, range)

The histogram shows residence time distribution of oxygen between nozzles and the catalyst surface. The average residence time is 12 ms.

If oxygen is injected as by Hashimoto or oxygen is injected as shown in Fig. 3 of our application and the whole space between distributor and catalyst (height of approx. 100 mm) contains gas-oxygen mixture, the residence time would be $100 \text{ mm} : 2 \text{ m/s} = 50 \text{ ms}$.

The residence time in our application of 12 ms is 4 times lower than 50 ms; therefore, the yield losses caused by non-catalytic oxidation are significantly lower.

The reduction of residence time is achieved
not by increased gas velocity
and not by reduction of distance between distributor and catalyst
but by special arrangement of nozzles, as described in claim 1 (jetted on the catalyst surface at an inclined angle).

An important difference to Hashimoto or to Reed, US 4,166,834 is not described by us but shown in Fig. 2 – 4.

The approximately conical jets in free space are in our application so short that the jets don't touch each other, or the cones with a typical half-angle of 7°-10° don't intersect in the space above catalyst.